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Research Article

Status and breeding population of the Saker Falcon (*Falco cherrug*) in the Caucasus Ecoregion: Regional perspectives and conservation challenges

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Abstract

This study provides a detailed overview of the Saker Falcon's status across the Caucasus, integrating contributions from collaborators from Azerbaijan, Georgia, Türkiye, Armenia, Iran and Russian Caucasus, and reviewing citizen science platforms such as eBird, iNaturalist, and Observation.org. We found that there are a lack of targeted studies on Saker Falcons across all Caucasian countries, however, increased research efforts may uncover previously undocumented nesting sites, improve threat assessments, and guide effective conservation actions critical for the species' survival in the Caucasus.

Key words: Citizen science, conservation, falconry, ornithology, population trend, raptor

Introduction

The Saker Falcon (*Falco cherrug*), the largest falcon species breeding in the Caucasus, is classified as "Endangered" by the International Union for Conservation of Nature (IUCN) (BirdLife International, 2024). According to BirdLife International's 2024 report, the global population is estimated to range from approximately 6,100 to 14,900 breeding pairs, with a median estimate of about 10,500 pairs. There is ongoing debate among researchers about the number of subspecies of the Saker Falcon, with some suggesting two (Kovács et al. 2014; Forsman 2016), while others propose as many as six (Karyakin 2023).

Saker Falcons are adaptable birds that can nest on ledges, loamy cliffs, or in the nests of other bird species, such as Eastern Imperial Eagles (*Aquila heliaca*), Rooks (*Corvus frugilegus*), Hooded Crows (*Corvus cornix*), and Ravens (*Corvus corax*). In addition to these natural nesting sites, in arid regions, they may also use artificial nest platforms on power transmission line structures and other constructions (Dzhamirzoev and Bukreev 2008).Their optimal habitats include rocky cliffs and slopes in open areas of dry foothills, as well as floodplain forests surrounded by steppe or semi-desert landscapes. Due to these habitat requirements, much of the greater Caucasus biodiversity hotspot, with its variety of open plains-type environment and rocky, montane sites, functions as an ideal location for the species. The Caucasus Ecoregion, spanning over 500,000 km^2, consists of three South Caucasian states (Armenia, Azerbaijan and Georgia) and parts of Russia, Türkiye and Iran (Fig. 1) (Zazanashvili et al. 2020). However, the current status of Saker Falcons in the ecoregion has not been adequately or comprehensively explored.

Annually, an estimated 6,825-8,400 Saker Falcons are trapped for falconry in the Middle East, with 77% being juvenile females, followed by 19% adult females, creating a significant gender imbalance in the wild population (BirdLife International 2024). The number of Sakers trapped in the Caucasus Ecoregion is uncertain as they are traded in an unregulated black market, but it is estimated that approximately 8% of the European population (c. 68-104 mature birds) are illegally killed or captured each year in Northern and Central Europe and the Caucasus (Brochet et al. 2019; BirdLife International 2024). In addition, it is estimated that 100–400 Saker Falcons are captured annually for the falconry trade in Iran alone (Kovács et al. 2014), further impacting the species' populations in the region. Along with this illegal hunting and capture, habitat loss, degradation and fragmentation are the other major threats to breeding bird populations like Saker Falcon in the ecoregion (Zazanashvili et al. 2020).

With the current lack of both published up-to-date data on the status of the species and the population trends in understudied regions, this paper aims to assess the current status of Saker Falcons in the wider Caucasus Ecoregion. In this study, we review the Saker Falcon populations and the breeding status of the species across multiple countries within the Caucasus Ecoregion. To do this, we utilised records from a combination of field surveys, citizen science data, and the literature to examine regional and country-level population trends in the 21st century. We also highlight the threats the falcon faces across the region as well as in individual countries. This study provides a timely update on the status of Saker Falcon in the Caucasus region and will be critical to informing conservation efforts to protect this sensitive species

Methods

Data collection methods varied across countries depending on the availability of resources and research effort. Data sources were mostly based on existing data sets but depending on the country, did include some new survey work.

Armenia. In Armenia, field observations took place from March to late June across semi-desert and mountain steppe habitats, focusing on identifying territorially active Saker Falcons and locating their nests. The work followed the European Bird Atlas 2 methodology (Voříšek et al. 2008), using a system of be-

Figure 1. Map of the Caucasus Ecoregion. © Manana Kurtubadze/grida.no

havioral codes (ranging between 0-16) to determine breeding likelihood, where higher codes indicated a greater probability of confirmed breeding (Voříšek et al. 2008). Interviews were conducted with inspectors from the RA Environmental Protection and Mining Inspection Body and heads of local Hunting Unions, aimed at determining possible legal violations, such as illegal hunting or capturing of the species. Interviews with pigeon breeders living near areas of known Saker Falcon concentrations were conducted to determine the potential damage that medium-sized raptors cause to them, and what measures they take in response to these threats. Field observations were complemented by targeted field searches in semi-desert and dry mountain steppe habitats, where the species is known to nest.

Azerbaijan, Georgia and Iran. In Azerbaijan, Georgia and Iran, where detailed information on Saker Falcons is limited, the study relied on local birdwatcher/expert observations and reports of potential nesting pairs in suitable habitats. In Azerbaijan, one nest was identified through regular field visits by birding enthusiasts, and historical records were scrutinised to cross-verify findings. In Georgia, searches were focused on known habitats, although recent surveys revealed very few confirmed nests. In Iran, where there are no historical or recent records of nesting, data were collected through interviews with birdwatchers and Department of Environment (DoE) officials. Reports of illegal trapping were also considered; however, reports where the origin of the captured birds was uncertain were omitted.

Russia. In Russia, data were largely drawn from published literature relating to the Caucasus region. Supplementary field searches were conducted to identify possible Saker Falcon breeding territories. This approach included re-

visiting historical nesting sites and gathering information from local wildlife researchers to estimate current population trends.

Türkiye. Since no prior long-term monitoring of Saker Falcons exists in Türkiye, the research team utilised data from eBird to analyse population trends across the country. In order to compare the trend results from eBird data for Türkiye with other countries, the authors also analysed eBird observations for the other territories.

eBird Data Collection and Analysis. Since Saker Falcon is treated by eBird as a sensitive species, and data on the species is not publicly available, we had to request data from eBird for records of the species in all of the countries in this study up until the autumn of 2024. We then used the R package auk (Strimas-Mackey et al. 2025) to filter the data for records of Saker Falcon from complete checklists submitted between 2001 and 2024 (September). We then removed any repeat or group observations of birds from the same date and location, ensuring that there were no duplicate sightings in the dataset. This filtering resulted in a total of 295 birds across all countries. We removed the Russian Caucasus from our eBird data analysis, as there was only a single record included in the dataset from that region. We then created a series of generalised linear models (GLMs, family = Poisson) to analyse the raw count of observations across and within countries. In each model, the count per year served as our response variable while date was our fixed effect.

Additionally, for Türkiye, we updated the analytical approach in Kittelberger et al. (2023) and re-analysed the same eBird data from that study to look at changes in the occupancy, or detection, of the species over the past couple of decades in the country. To do this, we used the 'pivot wider' function from the tidyr package (Wickham et al. 2023) to determine the presence or absence of Saker Falcon in every checklist at every location during the study period, with no detection scored as a 0 and all other detections scored as a 1. We then created two generalised linear mixed effects models (GLMMs, family = binomial), with detection set as the response variable (Bates et al. 2015) and both checklist location and eBird observer ID's as random effects. In the first model (M1), both date and sampling effort (the time duration of a checklist) were fixed effects (Kittelberger et al. 2023), and any individuals with NA's noted for sampling duration were removed from the analysis (n=14), whereas in the second model (M2), only date served as a fixed effect (allowing us to include all 64 birds from complete checklists). Statistical analyses and graphing were conducted in R version 4.3.1 (R Core Team 2023).

Results

Armenia. In Armenia, two occupied nests and five concentration areas were discovered, leading to an estimated population of 7 pairs (Aghababyan et al. 2025). These Saker Falcons were mainly found in the Central and Southern regions of the country, preferring semi-desert and dry mountain steppe as their habitat. The nests identified were located on cliffs in shallow grottos, positioned at heights of 10 and 30 metres from the base. Our breeding records were also used to estimate the Area of Occupancy (AOO) and the Extent of Occurrence (EOO) according to IUCN guidelines (IUCN Standards and Petitions Committee

2019) for the species. The species' area AOO in Armenia is estimated at 724 km^2, while the EOO is much larger, at 9,056 km^2 (Aghababyan et al. 2025).

While there is currently insufficient data to establish clear population trends, between 2019 and 2023, two occupied nests and 33 records of Saker Falcons were documented across the country by the specialists of BirdLinks Armenia NGO and the qualified volunteers. The increased number of records could be a result of increased efforts to combat illegal trapping for falconry in neighbouring countries like Georgia (Kovács et al. 2014) and Türkiye (Dixon 2007). Another possibility is that some birds, either escapees from falconers or from populations in northern Arabic countries, are migrating to Armenia as a favourable breeding site. Historically, some breeding pairs may have been overlooked during surveys, even though a large-scale survey was conducted in 1995 as part of the "Birds of Armenia Project" (Adamian and Klem 1999). During the implementation of the field data collection for that project, intensive mapping work was implemented from April to December of 1995, by 12 observers with high bird identification skills.

Azerbaijan. Saker Falcons are regular winter visitors in Azerbaijan, with an estimated 15–30 individuals recorded annually (MENR 2023). Patrikiev (2004) also notes that the species passes through the region during migration. Historical records, such as those of Gustav Radde in the 19th century, suggested possible breeding in the Talysh Mountains, but these claims have been disputed (Radde 1884; Patrikiev 2004). While there were no confirmed breeding pairs for many years outside the Karabakh region, this changed in 2021 when the first definitive breeding record was documented.

The nest discovered by local birdwatcher Abdin Abbasov in 2021 was in the Absheron district, at a location known as the first breeding site of the Lanner Falcon in the Caucasus (Burchak-Abramovich 1962). It was initially misidentified as a Lanner Falcon (*Falco biarmicus*) pair but later confirmed to be Saker Falcon with photos taken the following year by international birdwatchers (Fig. 2). Upon further review of the photos, it was revealed that the female of the pair might be a falconry escapee, as remnants of straps were visible around its tarsi. Although this pair, observed in the Absheron district, marked the first confirmed breeding outside Karabakh, the nest site was later taken over by Egyptian Vultures (*Neophron percnopterus*) in 2024 (Ifj. Turny Zoltán pers. comm.).

According to some sources, Saker Falcons have been breeding in Karabakh almost annually since 2014 at two different locations (Vasil Ananian, social media). Unfortunately, there is no current information about the status of these breeding pairs following the recent war, and concerns have been raised about the possible exploitation of these nests for falconry (anonymous military interviewee).

Social media posts and local falconers' reports indicate the possibility of other undocumented nests in the country. Juvenile Sakers are occasionally seen being trained by local falconers suggesting possible exploitation of unreported nests. This could mean that additional breeding pairs exist but remain undocumented by the ornithological community. Currently we estimate the number of breeding pairs in the country is at least 1-3 pairs.

Georgia. Georgia has limited available data on Saker Falcons, and breeding occurrences are sparse. There are reports of 1-3 breeding pairs in the early

Figure 2. A pair of Saker Falcons at a recently discovered nesting site in Azerbaijan, 05.03.2022. © Lukasz Ifczok.

2000s (Galvez et al. 2005; Kovacs et al. 2014). Since 2013, two nests have been documented in eastern Georgia, both on the Iori Plateau. However, both nests were abandoned by 2018, likely due to disturbance from local falconers or competition with other cliff nesting species. Egyptian Vultures took over one of the nests previously used by Sakers, successfully nesting there since 2020.

In 2021, a new nest was discovered along the Iori Plateau. Despite thorough searches in 2023 across historical nesting areas, such as the Iori Plateau (including the whole eastern Georgian steppes and surrounding areas), no active Saker Falcon nests were found, although Saker pairs were observed during these surveys, including at a new site in the territory of Vashlovani Protected Areas. However, as no nest was discovered this cannot be fully confirmed as a breeding location of the species in those years. Apart from these observations, one confirmed breeding site with three hatchlings was documented by an anonymous visiting ecotourist in 2024, and then also two nests in the same area by local ornithologists in 2025. Based on these observations, it is estimated that 1–3 nesting pairs may still exist in Georgia.

BirdLife International (2024) describes the breeding of Saker Falcons in Georgia as "occasional", while the Global Action Plan for the species (Kovács et al. 2014) identifies them as a regular breeding species with an estimated 1–3 pairs, in line with recent observations. Improved research and conservation efforts could potentially lead to the discovery of more breeding pairs in the country.

Iran. In Iran, the Saker Falcon belongs to the *cherrug* subspecies (Khaleghizadeh et al. 2017) and is considered an occasional breeder, with the estimate of pairs ranging from 10–100, the large range being due to poor and incomplete quantitative data availability (Kovács et al. 2014). The species is an uncommon breeder in northern and western Iran, but a regular winter visitor in the south

Caspian region. Despite these observations, detailed information about the Saker Falcon population in the Caucasus Ecoregion of Iran is scarce. There are no direct observations of breeding or nests in north-western Iran, including the provinces of East Azerbaijan, West Azerbaijan, Gilan, and Ardabil, an area spanning 115,000 km^2. However, indirect reports from local birdwatchers included a pair observed in summer months, suggest the possibility of a few breeding pairs in the area. By examining confirmed records from local birdwatchers from 2015 to the present, two records of two pairs during the breeding season were found (2016 in Gilan and 2020 in East Azerbaijan), along with a few different juvenile Saker Falcons. These observations potentially indicate breeding occurrences in the Ecoregion with estimate of 2-3 pairs (Fig. 3).

Russia. Currently, regular nesting of Saker Falcons is only observed in Dagestan (Buinakskaya Basin, Narat-Tyube Ridge), where 3–5 pairs are recorded (Dzhamirzoev and Ismailov 2009; author's data); these nests are regularly disturbed by poachers. The birds are of both the western (*cherrug*) and eastern (milvipes, korelovi) groups of subspecies, and in two cases, were females that had escaped from falconers (with fragments of straps on their tarsi).

Currently, in the European part of Russia outside of Dagestan, the Saker Falcon has completely stopped breeding (Karyakin 2021), with only non-breeding birds from Central European populations, Ukraine (Prommer et al. 2012; Prommer and Bagyura 2023) and Kazakhstan recorded here in the summer (author's data).

Estimates in the early 21st century suggested that southern Russia had between 5–20 breeding pairs, with 3–10 pairs specifically in Dagestan (Dzhamirzoev and Ismailov 2009; Belik 2020). One pair lived In the foothills of eastern Dagestan between 1994-1997 in the lower reaches of the Rubas River, but after the death of the male, records were limited to rare observations of solitary Saker Falcons between 1999-2003, after which the species disappeared.

In the summers of 2001-2002 Saker Falcons were observed several times in the foothills of Dagestan in the Kayakent district, and from 2006 to 2009 one pair bred on the rocks in the Buinaksk depression, where interactions with other territorial Saker Falcons were recorded (Ismailov 2012). From 2017 to 2019, 2–3 pairs were observed continuing to nest in the Buinakskaya depression and Narat-Tube ridge. Breeding territories were also reported near the settlements of Ekibulak and Kapchugay, along with other potential sites in southwestern Dagestan.

Elsewhere in the Western Caucasus, Saker Falcon sightings were extremely rare, with only a single record from 1932 (Averin and Nasimovich 1938) and nest was found in the Central Caucasus in 1954 (Molamusov 2017); however, sightings increased in the early 21st century. In the mountains of the Central Caucasus, the Saker was not recorded in the 1970s (Varschavskiy and Shilov 1989), but two pairs were found in 2004 in the gorge of the river Khasaut in Karachay-Cherkessia north of Elbrus, and in July 2006 a pair of the Saker were observed near the nesting area. Another pair with a brood was recorded in 2007 in the gorge of the river Malka in Kabardino-Balkaria, and at the end of April 2007, a solitary Saker Falcon was observed in the vicinity of the city of Kislovodsk in the south of the Stavropol Region, where it could potentially nest in rocky gorges (Dzhamirzoev and Bukreev 2008; Belik 2020). Finally, in 2002-2005 one pair of the Saker Falcons bred in an old Hooded Crow (Corvus cornix) nest in a tree among fields on a plain in the Terek valley in North Ossetia.

Figure 3. An immature Saker Falcon photographed in East Azerbaijan province, Iran in August 2020 © Sattar Shiri.

The fate of the Saker Falcons in Russian Caucasus depends on local offspring survival, birds escaping from falconry, and replenishment from the Kazakh population (Belik 2008). Additionally, despite regular releases of falcons by various nurseries, including the "Filin" nursery in North Ossetia, there has not been an increase in the number of summer records of Saker Falcons in the region (while the number of birdwatchers has increased significantly).

Türkiye. Saker Falcon has been recorded breeding or sighted during the breeding season at 20 different locations since 1960, with 15 of these records documented between 2000 and 2008 (Dixon et al. 2009). Many of the sightings have occurred in Eastern Anatolia, specifically in the montane steppe regions and agricultural grasslands, where rocky faces suitable for nesting are abundant (Fig. 4). Between 2000 and 2008, an increase in bird recording in Türkiye led to more sightings of Saker Falcons. Of 69 individual records in eBird for Türkiye during this period, 29 were during the breeding season (March to August), and most occurred in Eastern Anatolia. Prior estimates placed the number of breeding pairs in Türkiye between 10 and 99 (Cramp and Simmon 1980; Burfield and Bommel 2004). However, more recent sources estimate a population of 50 pairs (Dixon et al. 2009), while others suggest as few as 3–10 breeding pairs (Yavuz et al. 2021; Arslan and Ozkazanc 2022).

In our update to the detection analysis in Kittelberger et al. (2023) spanning records from 2001-2022, there was a total of 69 individual Saker Falcons from 64 submitted observations during that study period (we replaced any count of "X" for an observation with a 1; n=4). Here, we found that there was no sig-

nificant trend in detection across Türkiye — M1: -0.807 ± 0.792, z = -1.019, *p* = 0.308; M2: -0.483 ± 0.685, z = -0.704, *p* = 0.481. We also did not find that increased birding effort significantly affected how many Saker Falcons were observed — M1: -0.669 ± 0.682, z = -0.981, *p* = 0.327. Although most recent sightings align with historical breeding areas, there have been some new locations recorded in northeastern Central and Eastern Anatolia, as well as in the Aegean, Marmara, and Mediterranean regions.

eBird Analyses of Caucasus Region. There was no significant trend in the number of reported Saker Falcons over time across the Caucasus region during the study period according to eBird records (-0.003 ± 0.055, z = -0.047, *p* = 0.963; -, Table 1). At the country-level, there were no significant trends in Saker Falcon observations for any country (Table 1): Armenia (-0.012 ± 0.056, z = -0.211, *p* = 0.833; n = 20), Azerbaijan (+0.012 ± 0.019, z = 0.613, *p* = 0.540; n = 50), Georgia (>-0.001 ± 0.023, z = -0.018, *p* = 0.986; n = 53), Iran (+0.009 ± 0.028, z = 0.299, *p* = 0.765; n = 64), and Türkiye (-0.007 ± 0.014, z = -0.502, *p* = 0.616; n = 107).

Based on the comprehensive data collected from the aforementioned regions, the estimated breeding population of the Saker Falcon in the Caucasus Ecoregion, along with its population trend, is summarised in Table 2.

Discussion

Despite having national protection status in all the countries in the Ecoregion, Saker Falcons face an array of threats in the Caucasus.

The assessment of threats to the species in Armenia involved interviews with various stakeholders including inspectors, hunting union leaders, pigeon breeders, and customs officers (Aghababyan et al. 2025). Over the past decade, poaching of medium-sized raptors has been documented, although instances decreased between 2013-2018 and 2019-2023. Hunting union leaders disclosed that hunters possess over 200 medium-sized raptors, including two Saker Falcons shot more than 20 years ago (Aghababyan et al. 2025). Pigeon breeders generally have a negative attitude toward raptors and limited knowledge about them. While no cases of the export of wild-caught Saker Falcon have been reported, six CITES certificates were issued for captive-reared birds in 2021 (Aghababyan et al. 2025). Although illegal trapping for falconry is considered a low threat, the use of poisoned pigeons by pigeon breeders is alarming, with about 13% of breeders reportedly using this method. This makes the scope and severity of poisoning a significant concern (Aghababyan et al. 2025). Additionally, poaching of trophy individuals and electrocution are still concerns, requiring further investigation into enforcement measures and strategies to mitigate these threats (Aghababyan et al. 2025).

Inadequate knowledge and skills among customs inspectors exacerbate these risks (Aghababyan et al. 2025). Similarly, poaching for trophies is a moderate threat to raptors, but the lack of expertise among inspectors from the Environmental Protection and Mining Inspection Body warrants further investigation to understand how this knowledge gap affects raptor conservation (Aghababyan et al. 2025).

In Azerbaijan, the main threat to Saker Falcons and other large falcons is the capture of chicks from nests or trapping for falconry. Like Armenia, inadequate

Figure 4. Eastern Anatolian montane steppe landscape where Saker Falcon has been detected by the authors in north-eastern Türkiye. Location name has been withheld due to the sensitivity of the species. Top photograph taken on June 30, 2019 and the bottom on November 23, 2021, both by KDK.

knowledge amongst customs inspectors causes the smuggling of raptors to go unnoticed. Since 2000, the CITES database lists 8 live Saker Falcons and 20 Peregrine falcons of mostly “unknown origin” exported from Azerbaijan to Qatar and the United Arab Emirates.

Hybridisation between escaped and wild raptors is a well-documented concern, as first-generation hybrids (F1 hybrids) are fully viable (Rivas-Salvador et al. 2021). For instance, a breeding female Saker Falcon in Azerbaijan, believed to be a falconry escapee, could introduce unknown genes into the local population. The increasing number of escapees in the Caucasus region further threatens the genetic integrity of breeding populations, calling for urgent conservation measures. Hybridisation has also been identified as a potential future threat in Iran (Kovács et al. 2014).

In addition to escapees, deliberate releases of birds previously used in falconry have occurred in the region. Reports indicate that around 250 birds, mostly Peregrines but including some Saker Falcons, were released into the Azerbaijani wilderness between 2020 and 2023, posing a risk to local populations' genetic integrity (Farajli 2024). In 2003 alone, 46 Saker Falcons that were used in falconry were also released in Iran (Muller 2013; Taiyari and Hashemi 2020). Similar releases have been noted in the Russian Caucasus, underscoring the need to suspend these campaigns unless comprehensive genetic testing ensures the birds are non-hybrids.

In Iran, illegal trapping of the live birds to sell them on the black market, habitat loss and a decrease of prey species are identified as major threats for the fate of Saker Falcon (Taiyari and Hashemi 2020).

In Georgia, the Global Action Plan for the species (Kovacs et al. 2014) lists the main threats as unknown, although it is anticipated that they mirror those in neighboring countries, especially disturbance by falconers and conflict with pigeon breeders which can be considered the key threats for the species in Georgia.

Although not previously known to occur locally, pigeon keepers have recently begun using an unidentified poison on pigeons, which are then released as bait to target and kill peregrine falcons. This practice also poses a significant threat to local, wintering, and migrating Saker Falcons within the country. Therefore, increased attention and conservation efforts are urgently recommended.

The decline of Saker Falcons in the North Caucasus though is linked to several factors, including the intensive use of toxic pesticides in the mid-20th century, chick removal by poachers in the late 20th and early 21st centuries, the shooting of adult birds, and possible electrocution on power lines. The nearest large population, located on Kazakhstan's eastern Caspian Sea coast, is severely impacted by poaching (Karyakin et al. 2005, 2015a, 2015b, 2023; Moshkin 2010; Pfeffer and Karyakin 2010; Levin 2011, 2012). Juvenile Sakers from this population migrate north to the Southern Urals by May-June, and south through Dagestan and Azerbaijan by July-August.

In the last decades of the 20th century, the Saker Falcon underwent a notable population decline in Türkiye as a result of several factors such as steppe habitat loss, reductions in ground squirrel populations (*Spermophilus* spp.), and falcon trapping (Dixon et al. 2009). Although Saker Falcons do not exclusively rely on sousliks, up to 80% of their diet in Central and Eastern Anatolia consists of these ground squirrels (Dixon et al. 2009). Similar diet is noted from Kazakhstan where it consisted of 73% mammals (58% *Spermophilus* spp.), 26% birds (mainly Galliformes and corvids), and 1% reptiles (Orta et al. 2020). Consequently, any decline in these prey species can affect the breeding bird distribution. The Anatolian ground squirrel (*Spermophilus xanthoprymnus*) primarily inhabits dry, stony steppes in eastern Anatolia, with small populations in Armenia and north-western Iran (Krystufek and Vohralík 2012). Similarly, the Little Souslik (*S. pygmaeus*) is restricted to the Northern Caucasus Ecoregion. While an isolated population exists in Dagestan, its presence in Georgia remains unconfirmed (Krystufek and Vohralík 2012). There is a single record of Anatolian ground squirrels (*S. xanthoprymnus*) in the Javakheti region of Georgia that could be a good food source, but as noted they have

Table 1. The population trend of Saker Falcons according to the raw count of observations of birds from eBird checklists submitted from the Caucasus region between 2001 and 2024. Results are from generalised linear models (GLMs) testing the effect of year on the count of birds. SE = standard error, and n = the number of observations for a given region.

Country	Estimate	SE	z value	p value	n
All countries	-0.003	0.055	-0.047	0.963	294
Armenia	-0.012	0.056	-0.211	0.833	20
Azerbaijan	0.012	0.019	0.613	0.540	50
Georgia	>-0.001	0.023	-0.018	0.986	53
Iran	0.009	0.028	0.299	0.765	64
Türkiye*	-0.007	0.015	-0.502	0.616	107

* Note that records for Turkiye presented here are representative of the entire country, rather than strictly Eastern Anatolia

Table 2. Estimated breeding population of Saker Falcon (*Falco cherrug*) in the Caucasus Ecoregion and their status.

Country/Region	Number of breeding Saker Falcons (in pairs)	Quality of the estimate (1–5)	Population trend
Armenia	7	4	uncertain
Azerbaijan	1–3	3	uncertain
Georgia	1–3	4	uncertain
Russia (Caucasus)	3–5	4	decreasing
Türkiye (Eastern Anatolia)	3–6	3	stable
Iran (North-West)	2–3	2	decreasing
Total (Caucasus Ecoregion)	17–27		decreasing or uncertain

only recently been discovered and the population in the country is too low to provide a food base for Saker Falcons. During pair formation and territorial settlement, when sousliks hibernate, Saker Falcons in Anatolia primarily feed on birds (Dixon et al. 2009). Further research is needed to understand their diet during the breeding season, as some nesting sites in the Ecoregion are not associated with any souslik populations. However, other rodent species, such as Libyan Jird (*Meriones libycus*) might be important prey source for the breeding Saker Falcons in the Caucasus Ecoregion.

Falcon trapping peaked in Türkiye in the 1980s, when hundreds of falcons were trapped annually, many of them likely to be Saker Falcons (Bär 1997; Dixon et al. 2009). Although trapping continues today, some of these birds are destined for smuggling to countries like Syria (Hürriyet 2020; Bilisim 2023). While most captured Saker Falcons are likely migrants, some from Türkiye's breeding population may also be targeted (Dixon et al. 2009). The number of Saker Falcons in Türkiye is probably fairly low, particularly in the Caucasian part of the state, with a relatively limited number of sightings over the past decade. We found that there has been no significant change in the population trend (based on detections) of the species in the country since 2001, although this result may be influenced by the overall scarcity of sightings during the time pe-

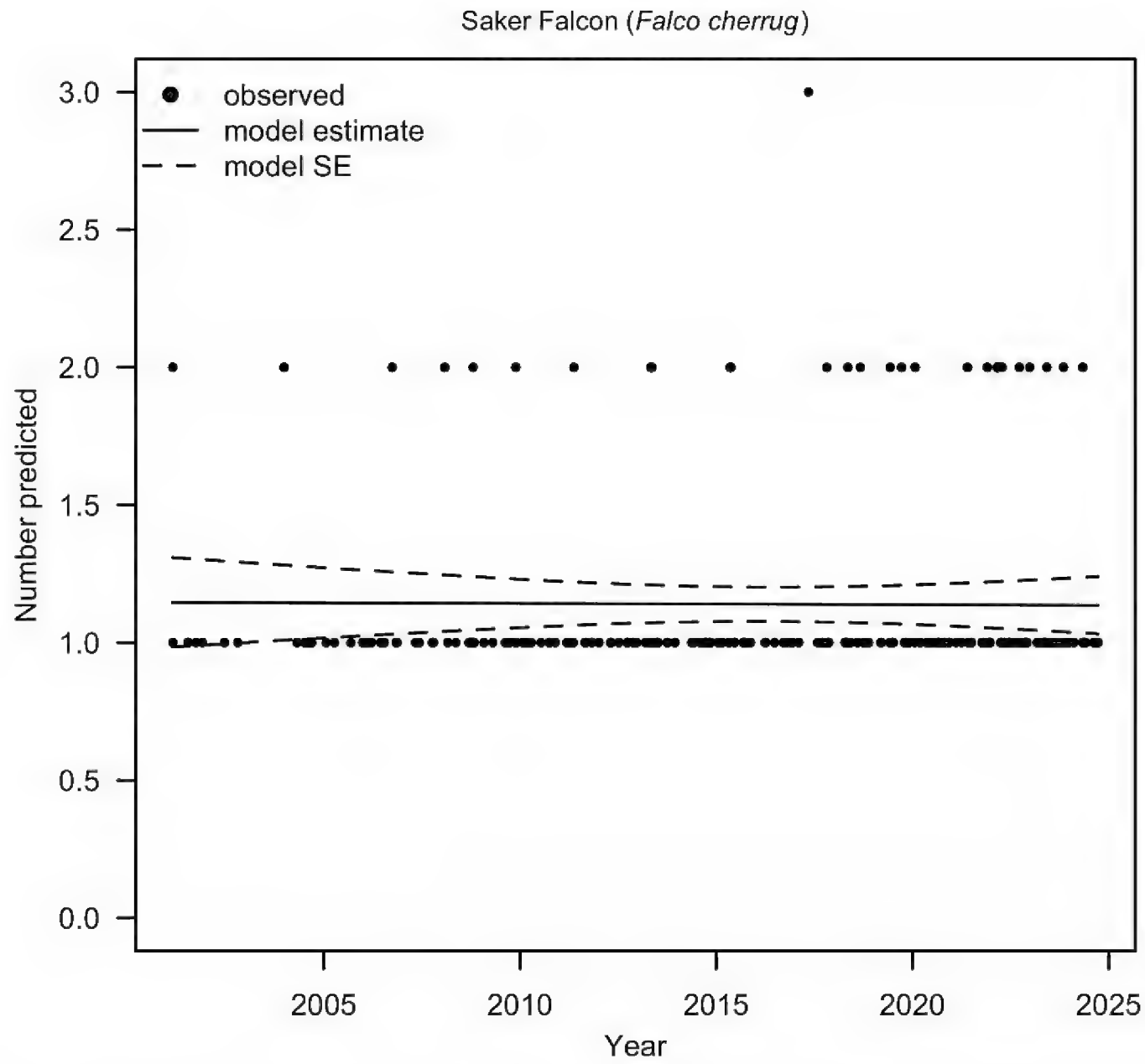

Figure 5. The population trend of Saker Falcons across the Caucasus region between 2001 and 2024. This trend is based on the proportional presence-absence of the species from complete eBird checklists from five countries in the region. While the x-axis depicts the year, individual dots represent a specific date. The species did not undergo a significant change in trend during the study period according to eBird records (-0.003 ± 0.055, z = -0.047, p = 0.963). The model prediction (± 95% confidence interval) of the trend is based on a GLM estimate.

riod (2001-2022). While there has been an increase in the number of sightings in the country since 2019, this is likely to be a result of increased birding effort (Dixon et al. 2009), as the number of eBirders in Türkiye has substantially grown in the last couple decades (Kittelberger et al. 2023).

Finally, when looking at population trends in Saker Falcons across the Caucasian region using eBird data, we found no significant change in the number of falcons (Fig. 5), at either the regional or country level (Table 1). On the surface, this would suggest that Saker Falcon populations have not significantly declined in the region this century and are stable. However, this would seem to counter findings on the ground from surveys, and trends from eBird observations may be compounded by the overall scarcity of submitted sightings during the time period. Even in Türkiye, where there has been the most consistent and largest eBird effort in the past couple of decades for the region (Kittelberger et al. 2023), we still found no significant trend (Table 1). This result in a well-birded country could signify several things across the region. Saker Falcons may

be hard to find due to factors like their landscape preferences or habits, and therefore they are not being detected by most eBirders and the data are not an accurate reflection of the population sizes. Additionally, since Saker Falcon can be challenging to identify in the field and distinguish from similar species like Lanner Falcon (Forsman, 2016), potential misidentifications on citizen science platforms like eBird, iNaturalist, Observation.org may indicate that there are more individuals in the region than in reality. Since there are already low numbers of Saker Falcons in the Caucasus today, misidentifications could result in population trends derived from citizen science data as being more optimistic than those from on-the-ground surveys. Therefore, we suggest that heightened scrutiny and caution be applied to results from platforms like eBird for sensitive species such as Saker Falcon, at least in the Caucasus region where citizen science is still a growing activity (Kittelberger et al. 2023), and regional coverage and skill set of users may not be uniform; more stringent vetting of sightings by eBird reviewers and curators on other platforms will also help improve the quality of data. However, another explanation may be that the species has become naturally scarce after a prolonged period of drastic decline and targeted persecution in the area, and the population has now stabilised at a low level. Additional and more focused field surveys of potential locations where birds may occur, especially in countries which have not established monitoring programs for the species, will help better reveal the status of Saker Falcon populations in the region.

Conclusion

Despite the gaps in available data, particularly in some regions, this study aims to provide a detailed overview of the Saker Falcon's status by country and identify the primary threats facing this species. Although eBird data did not reveal a significant trend in reported Saker Falcon sightings across the Caucasus during the study period, expert assessments estimate the current breeding population at only 17–27 pairs, suggesting a possible decline or at best an uncertain trend (Table 2). This discrepancy may be partially explained by misidentifications on citizen science platforms such as eBird, iNaturalist, and Observation.org, where recent photo reviews have revealed confusion between Saker Falcons and other large falcons, including Lanner and Peregrine Falcons. As a result, we recommend that both contributors and data reviewers approach records of large falcons in the region with particular care to ensure accurate identification, which is essential for improving population trend analyses such as ours. Finally, increased efforts may reveal previously undiscovered nesting sites in Azerbaijan, Georgia, and Iran, and improve our understanding of the threats faced by the species.

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Additional information

Conflict of interest

The authors have declared that no competing interests exist.

Ethical statement

No ethical statement was reported.

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Author contributions

ZF and TAH conceived the original idea for the project; ZF with support from KDK wrote the manuscript and acquired the eBird data, and CJT and KDK statistically analysed the eBird data and created the respective statistical figure and table; KA, NP, MH, IK, VB, ÇHŞ, and EÇ wrote parts of their respective countries; all authors gave final approval of the manuscript.

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Data availability

All of the data that support the findings of this study are available in the main text or Supplementary Information.

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